



# L1 RCT Studies

*Pamela Chumney*  
University of Wisconsin

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## Simulation

- Old vs new TDR plots
- Other trigger rates and efficiencies
- Summary



# Latest Simulation Results

## CMSIM 116 Production

- Previously CMSIM 114
- Pileup at  $10^{34}$  and  $10^{33} \text{ cm}^{-2} \text{ s}^{-1}$  used

## ORCA 4\_2\_0

- Previously Private Code

## Updated Trigger TDR plots and tables

- Full update expected in November

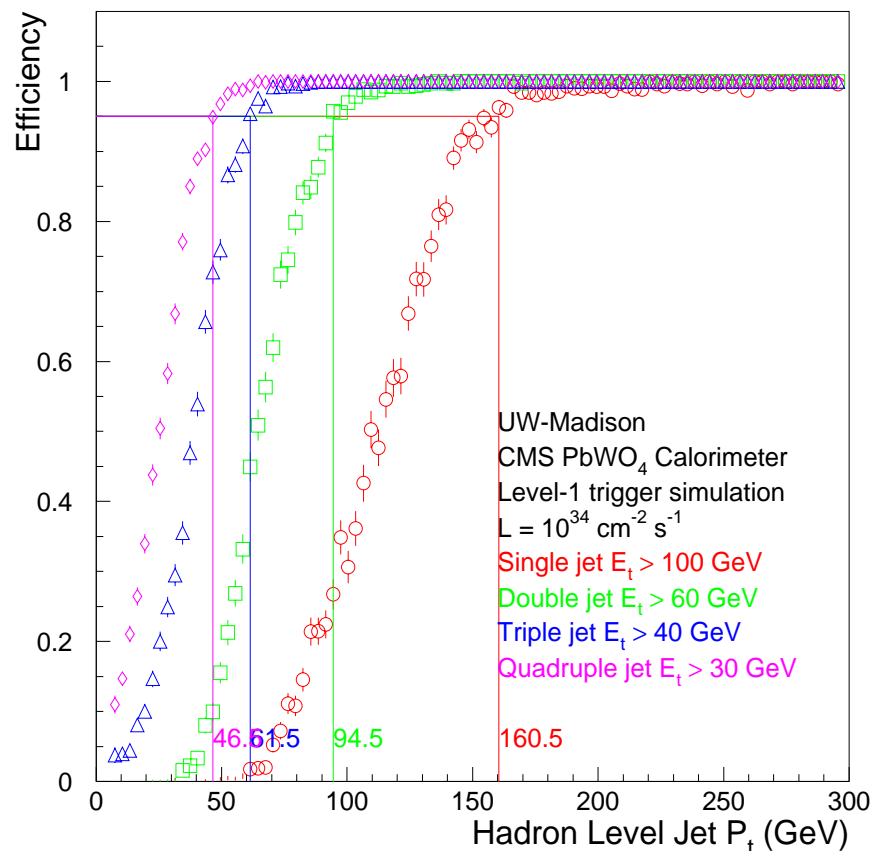
## Only $|\eta| < 3$ used

- HF rates very high
- Waiting for validation of HF (ORCA?)



# Jet Efficiencies

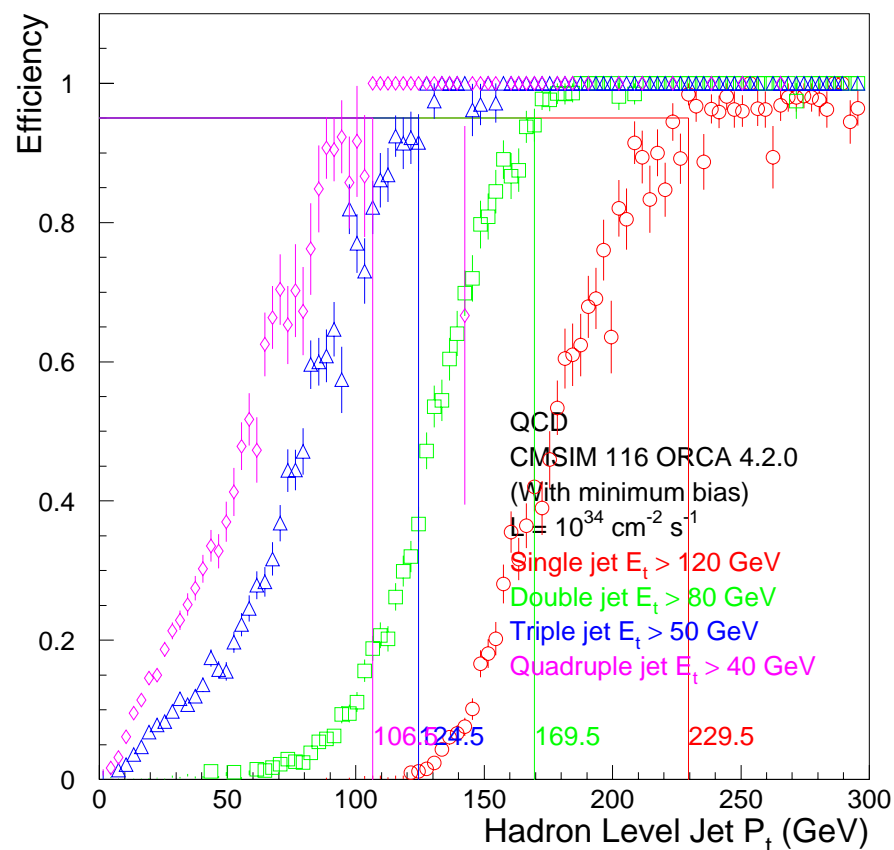
QCD jet efficiency - 12x12 algorithm



**$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$  with Pileup**  
**Cutoffs of 100, 60, 30, and 20 GeV**

**Higher cutoffs necessary to control rate**  
**Turn on of efficiency also seems worse - 160% → 195% of cutoff value for single jets**

QCD jet efficiency - 12x12 algorithm



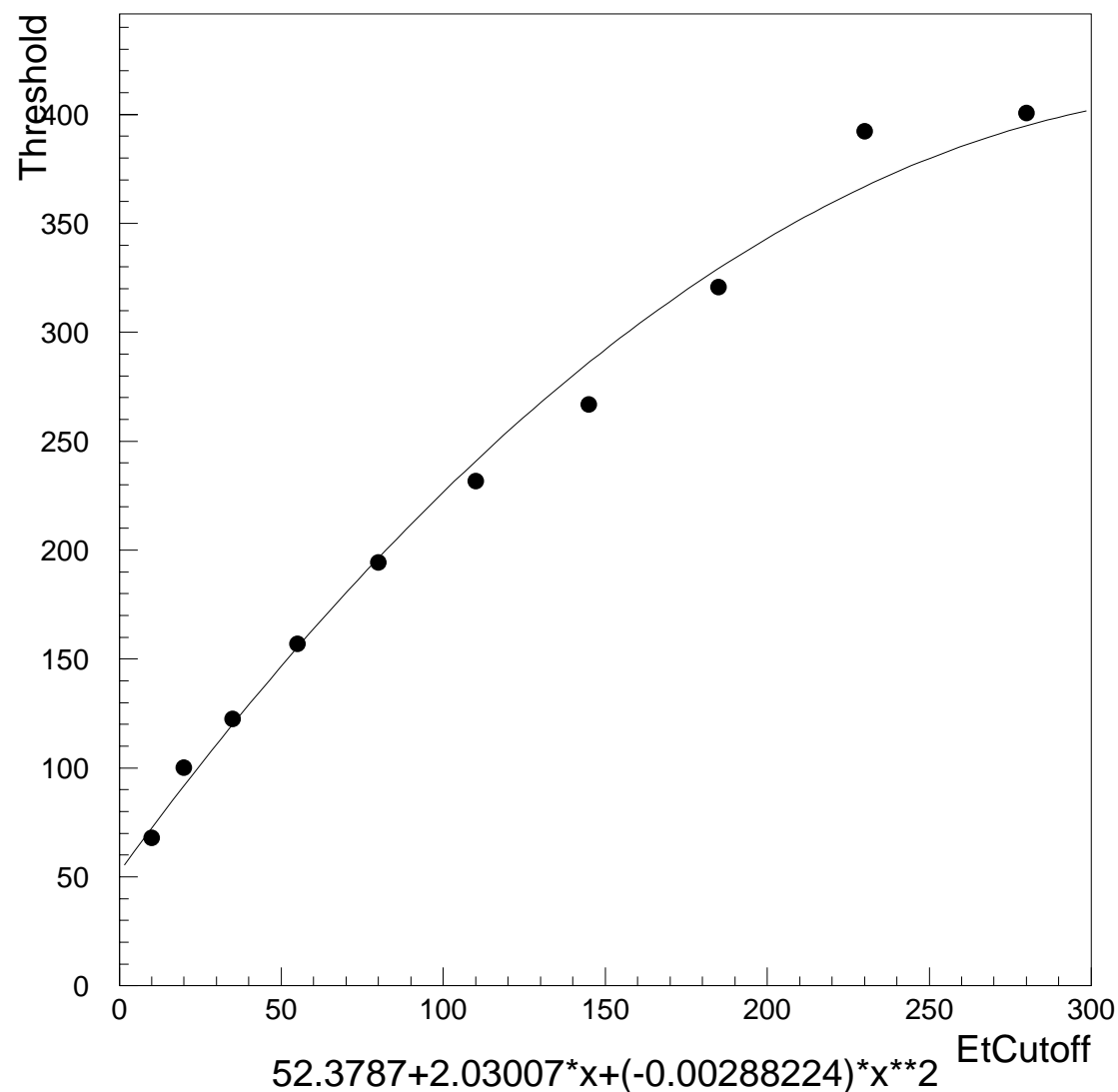
**$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$  with Pileup**  
**Cutoffs of 120, 80, 50, and 40 GeV**



# Individual Jet Calibration

**Fit to second  
order polynomial  
instead of  
straight line**

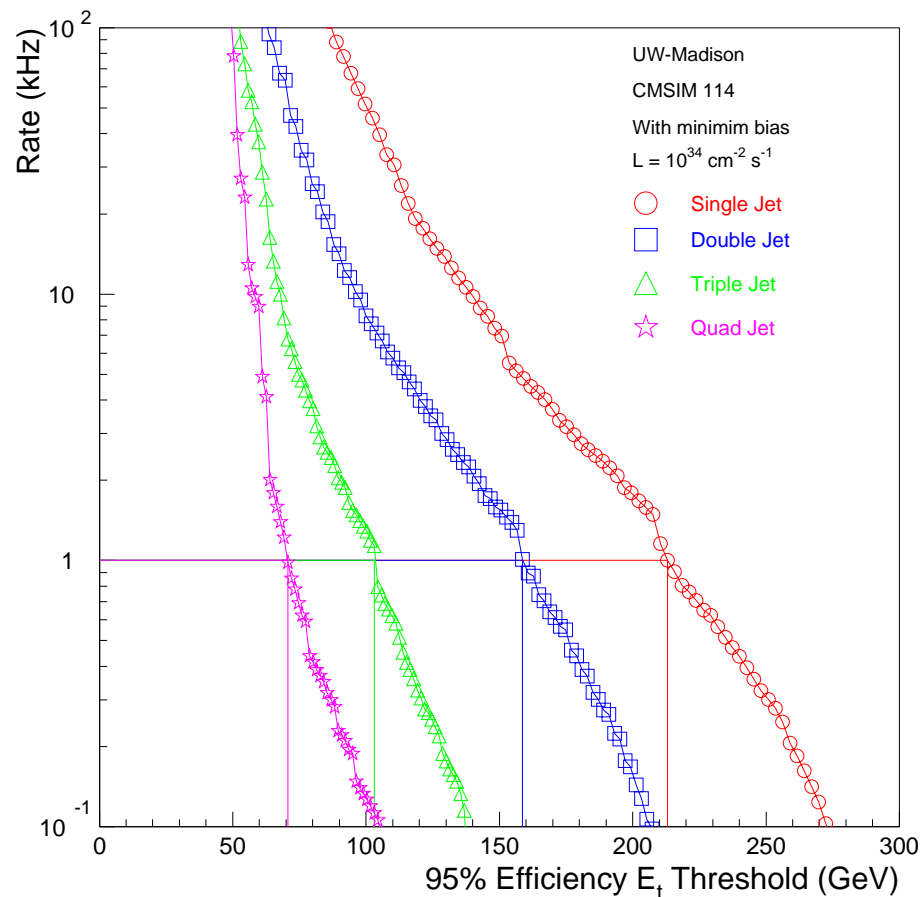
12x12 jet calibration



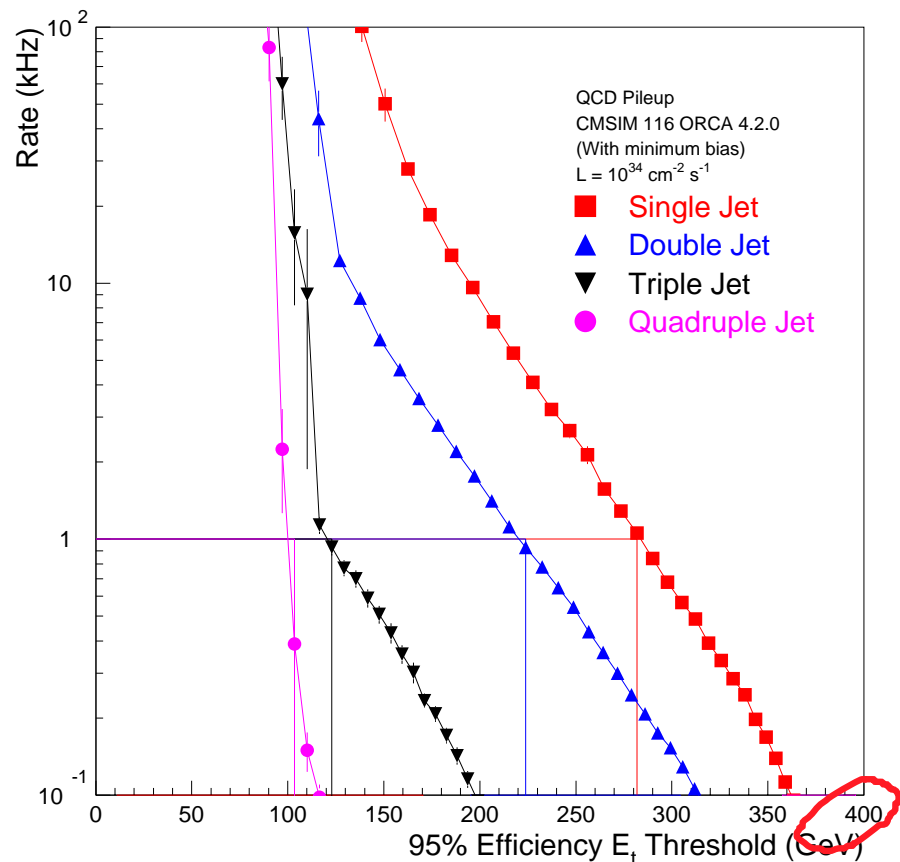


# Jet Rates

12x12 Jet Trigger rate (new algorithm)



Jet trigger rates



**Rates higher for 95%  $E_T$  Threshold - jet energy resolution?**



# Jet Energy Resolution

Jets with  $90 < E_{\text{TMC}} < 110 \text{ GeV}$

$|\eta_{\text{MC}}| < 2$

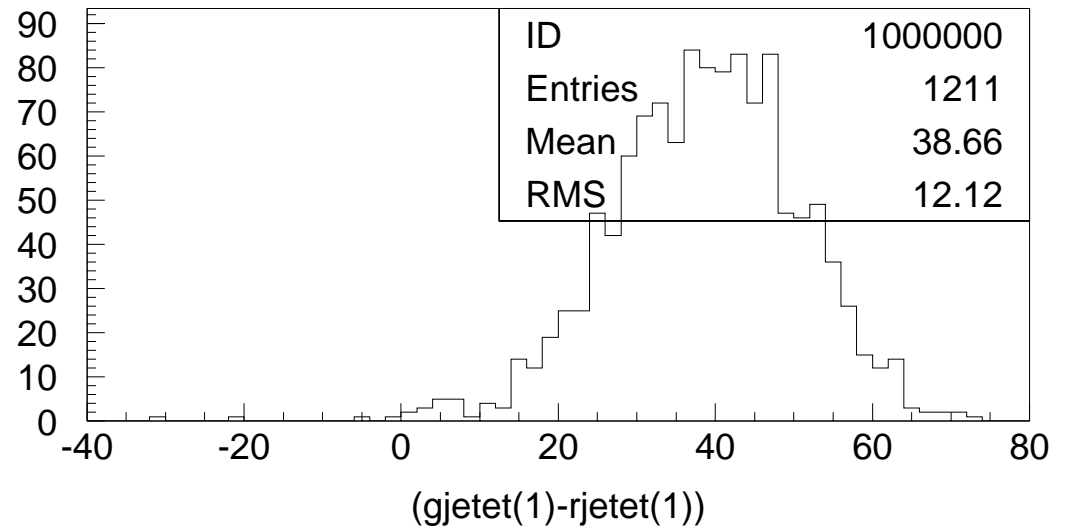
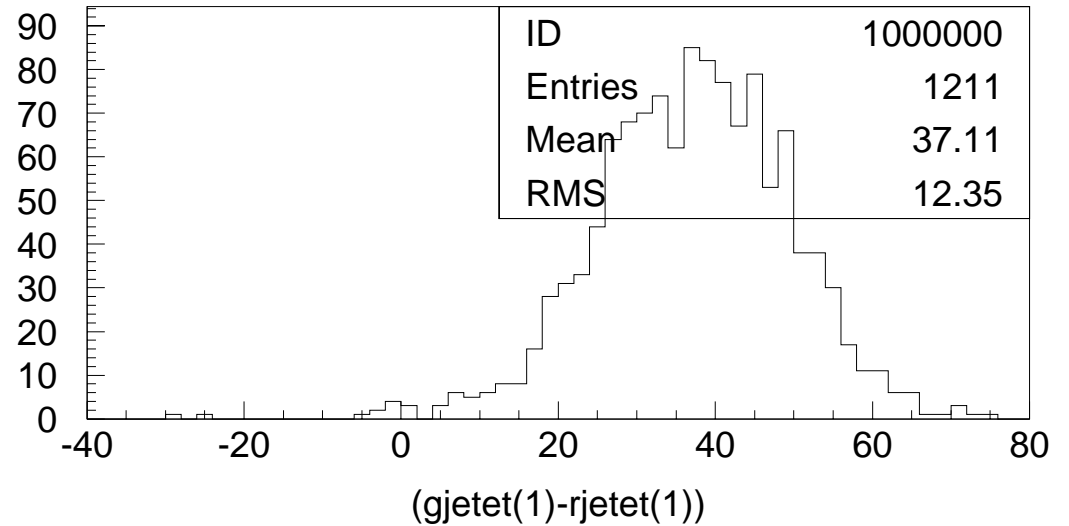
Top Plot:  $10^{33} \text{ cm}^{-2} \text{ s}^{-1}$

Bottom Plot:  $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$

Results are similar:

RMS  $\sim 12 \text{ GeV}$

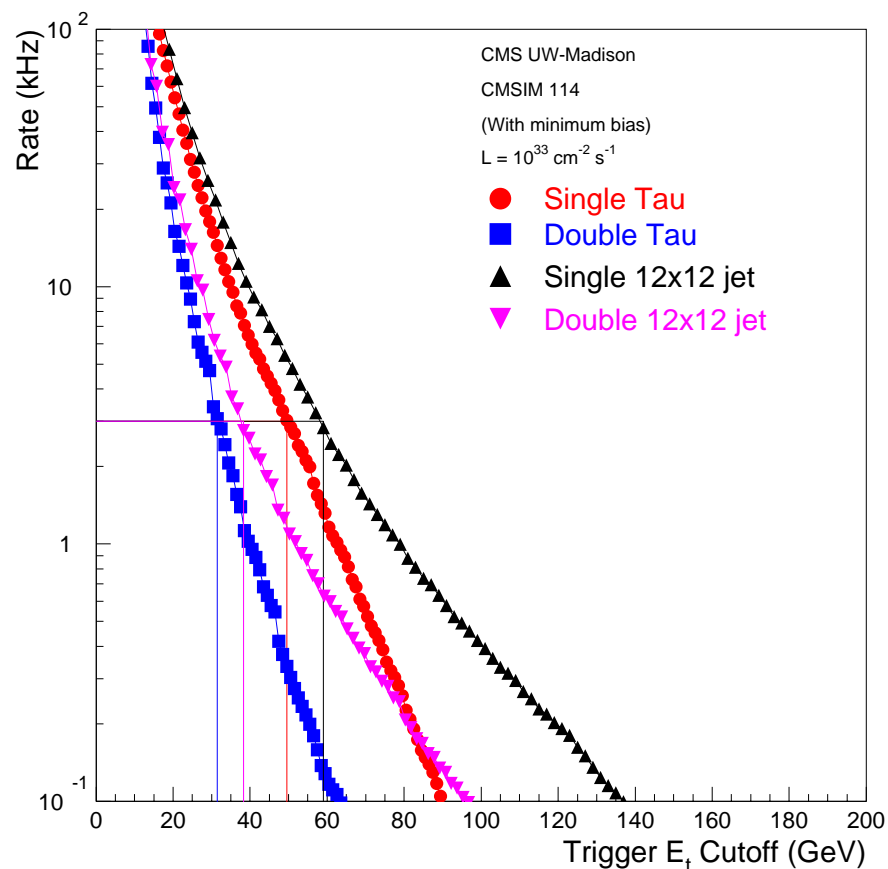
offset  $\sim 40. \text{ GeV!}$



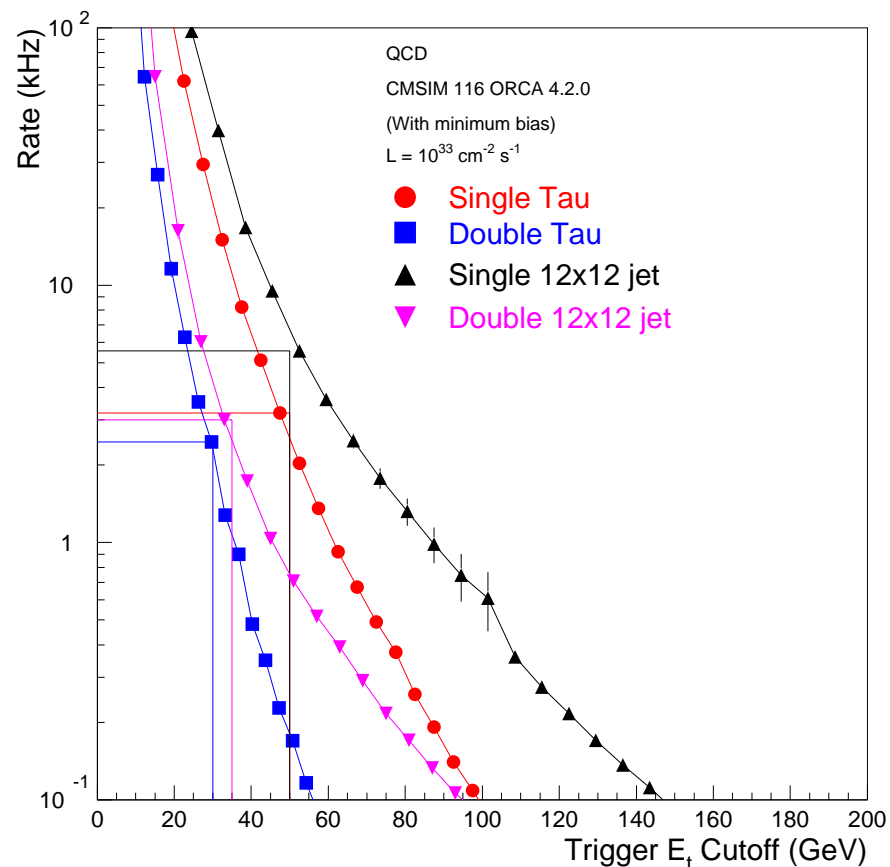


# 10<sup>33</sup> Jet/τ Rates

Tau and jet trigger rates



Tau and jet trigger rates

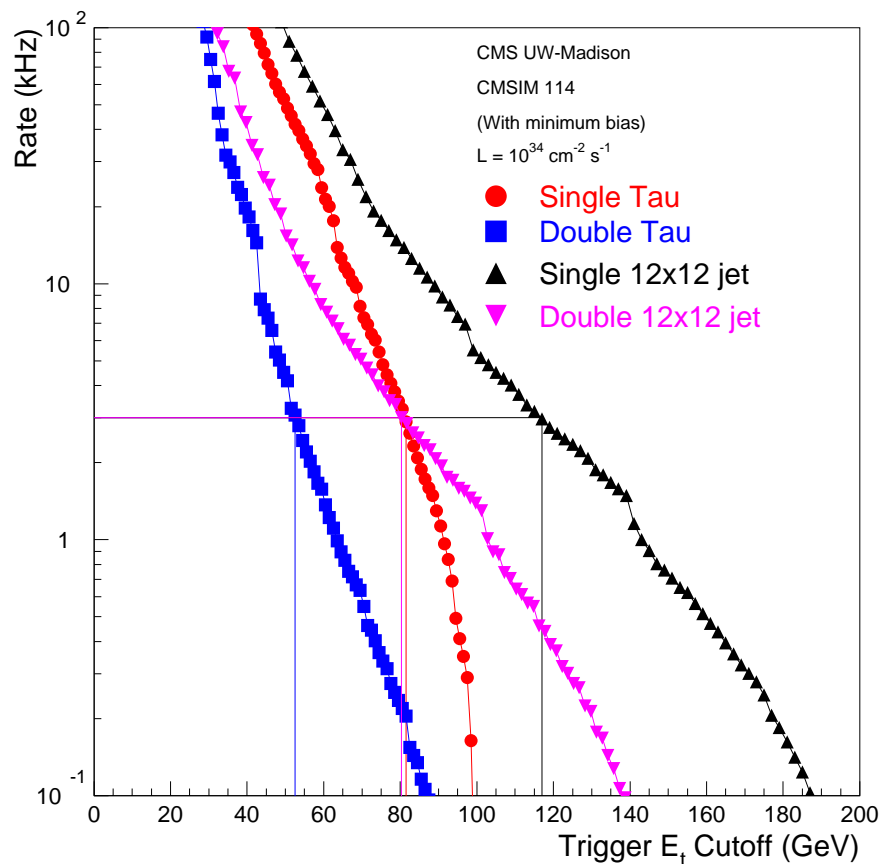


**Tau is just a jet with the Tau Veto off.  
Jets are any type of jet, regardless of veto.  
Cutoffs are 40 for single  $\tau$ , 20 for double  $\tau$ .  
Rates similar for both analyses.**

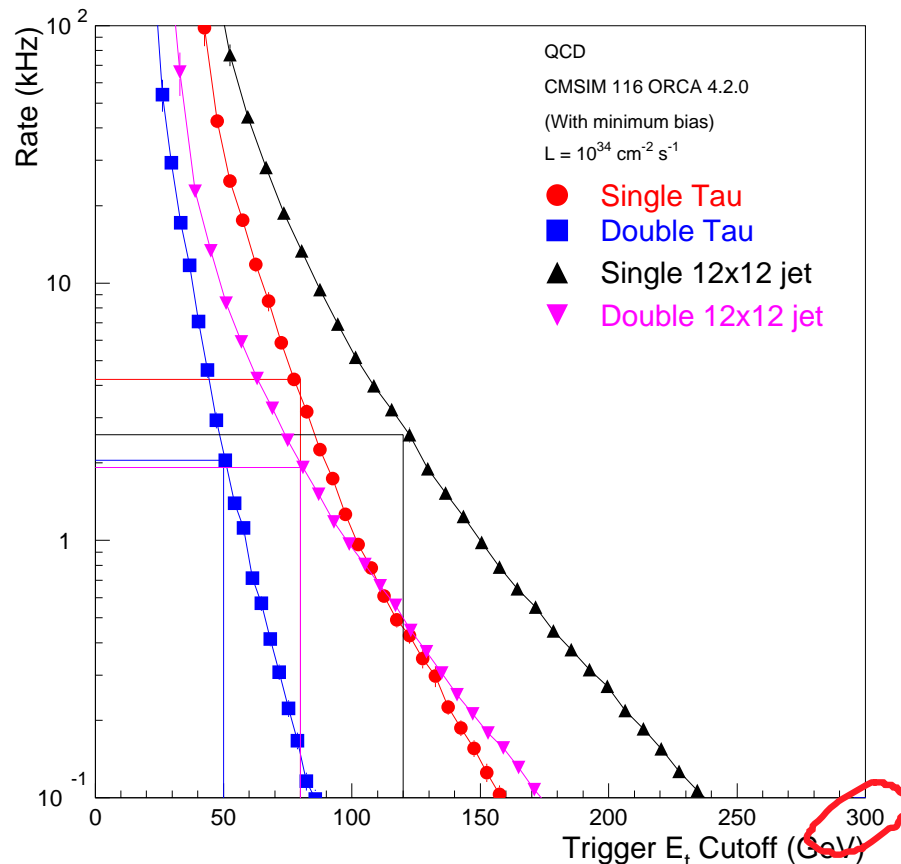


# $10^{34}$ Jet/ $\tau$ Rates

Tau and jet trigger rates



Tau and jet trigger rates



**Cutoffs are 80 GeV for a single, 50 GeV for a double.**  
**Rates are similar, tails are smoother for new analysis - more statistics.**



# Comparison of $10^{34}$ Jet Rates (1)

ET Cutoff (Gev)	Old Rate (kHz)	New Rate (kHz)	Newer Rate (kHz)
100	1.0	5.1	5.1
60	0.7	5.9	5.8
30	1.3	11.4	5.7
20	1.0	96.0	27.6

**Old rate is from CMS114+Private Code: Rate= $\mathcal{L}\sigma$**

**New rate is from CMSIM116+ORCA420: Rate= $\mathcal{L}\sigma$**

**Newer rate from CMSIM116+ORCA420: Rate using weights from Branson & Trepagnier Note**



# Comparison of $10^{34}$ Jet Rates (2)

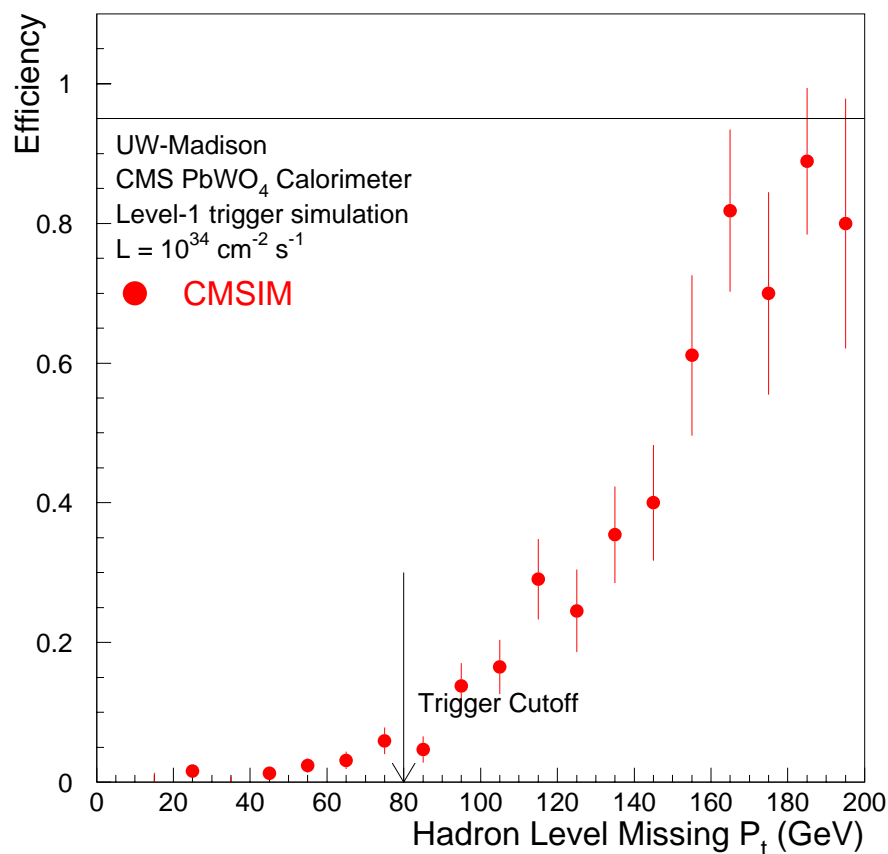
ET Cutoff (GeV)	New Rate (GeV)	Newer Rate (GeV)
120	2.6	2.5
80	1.9	1.9
50	0.6	0.6
40	0.1	0.1

**New and Newer rates are as on previous slide.**

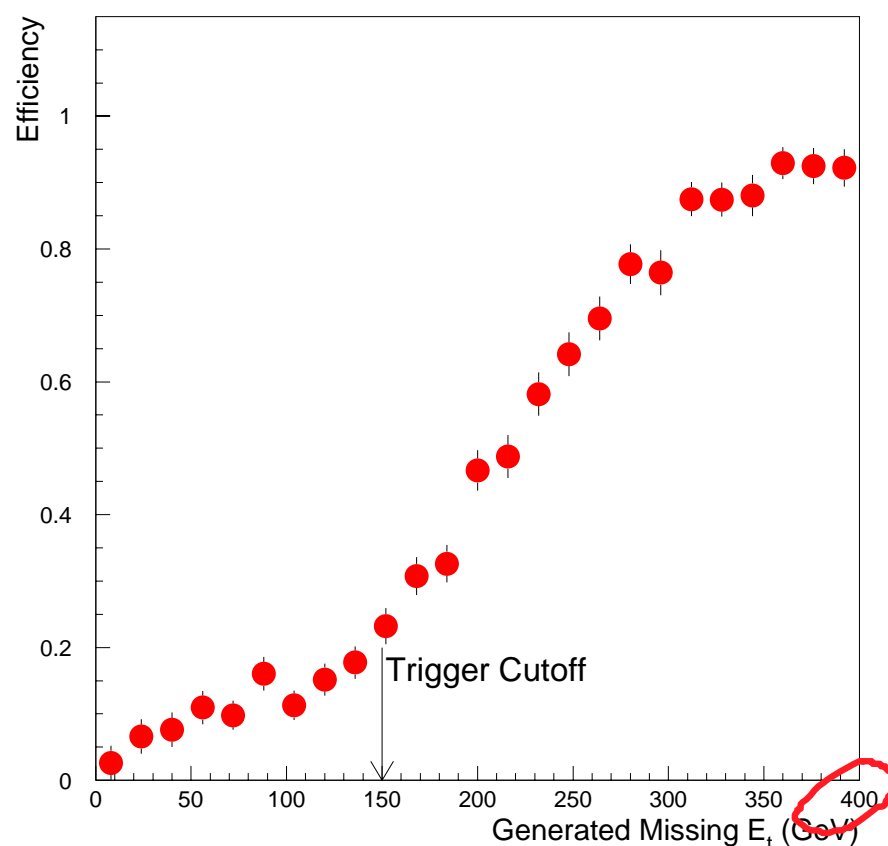


# Missing $E_T$ Efficiency

Missing  $E_T$  Trigger at  $L = 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$



mSUGRA Missing  $E_t$  Efficiency



**$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$  with Pileup.**

**Efficiency for mSUGRA events.**

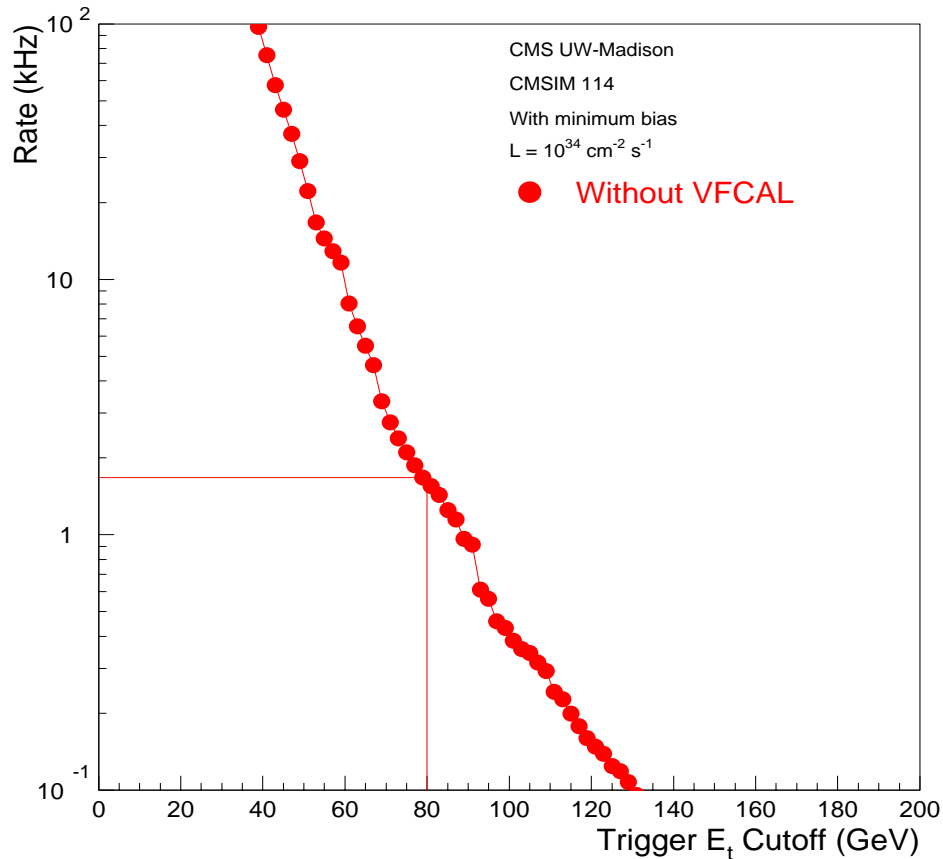
**Cutoffs at 80 GeV and 150 GeV.**

**Energy resolution affecting turn on of efficiency? Turn on at 150%→233% of  $E_T$  cutoff.**

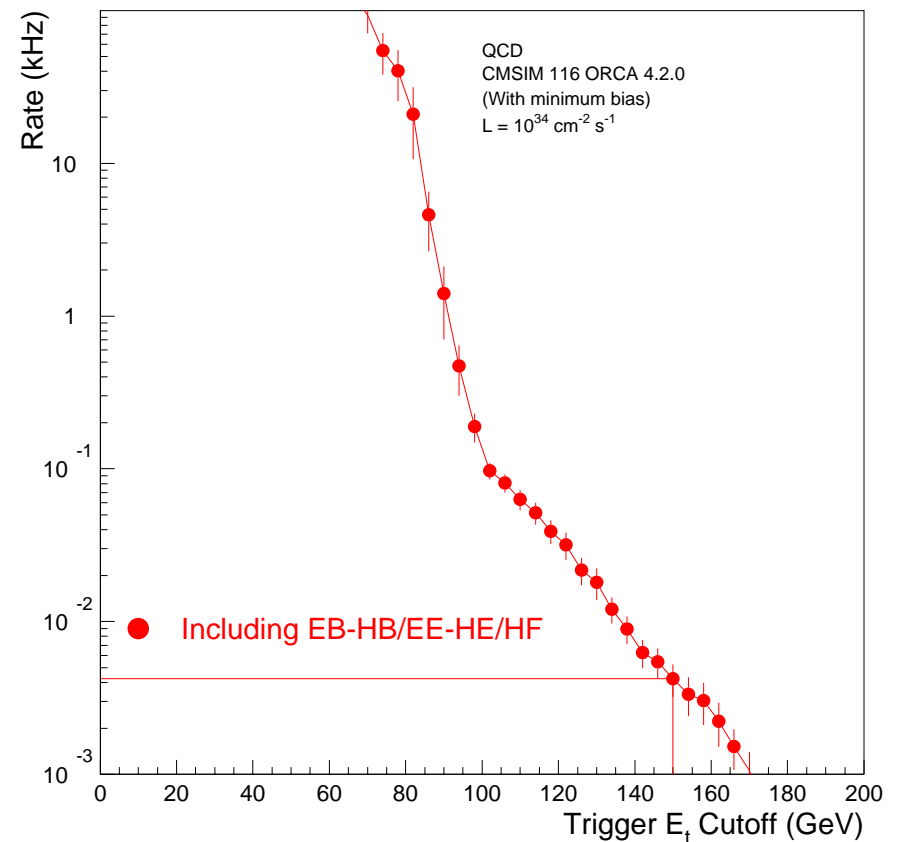


# Missing $E_T$ Rate

Missing  $E_T$  trigger rate



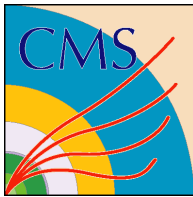
Missing  $E_T$  trigger rate



**$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$  QCD events with Pileup**

**Steep slope in new rate is where pileup is "dying out".**

**Rates at Cutoff values are 0.7 and 0.01 kHz.**



# 10<sup>33</sup> Trigger Rates and Cutoffs

Trigger Type	E <sub>T</sub> cutoff	95% Eff. Thr. (GeV)	90% Eff. Thr. (GeV)	Individual Rate (kHz)
Electron	14	24*	20*	9.8
Dielectron	8	15*	12*	0.2
Trielectron	5			0.003
Tau	40			3.2
Double Tau	20			2.5
Jet	70	150	130	2.5
Dijet	45	120	105	1.0
Trijet	30	85	75	0.1
Quadjet	20	80	65	0.01
Jet + Electron	40 & 10			2.2
Tau + Electron	30 & 10			0.2
Missing E <sub>T</sub>	100		150	0.01
Electron + ME <sub>T</sub>	10 & 50			0.1
Jet + ME <sub>T</sub>	30 & 50			0.1
Sum E <sub>T</sub>	500			0.02
<b>Electrons are non-isolated.</b> <b>Many cutoffs are higher. (*old values)</b>			<b>Total</b>	<b>~15</b>



# 10<sup>34</sup> Trigger Rates and Cutoffs

Trigger Type	E <sub>T</sub> cutoff	95% Eff. Thr. (GeV)	90% Eff. Thr. (GeV)	Individual Rate (kHz)
Electron	27	35*	33*	7.3
Dielectron	14	22*	20*	0.1
Trielectron	10			negligible
Tau	80			4.2
Double Tau	50			2.0
Jet	120	230	210	2.6
Dijet	80	170	165	1.9
Trijet	50	125	115	0.6
Quadjet	40	110	90	0.1
Jet + Electron	60 & 14			1.9
Tau + Electron	50 & 14			2.1
Missing E <sub>T</sub>	150		350	0.004
Electron + ME <sub>T</sub>	14 & 80			0.1
Jet + ME <sub>T</sub>	50 & 80			0.1
Sum E <sub>T</sub>	1000			0.02
<b>Electrons are isolated.</b> <b>Many Cutoffs Higher. (*old Values)</b>			<b>Total</b>	<b>~15</b>



# Efficiencies for Physics Processes

Channel	$10^{33}$	$10^{34}$
$H(200) \rightarrow \tau\tau \rightarrow jj$	0.98	0.57
$H(500) \rightarrow \tau\tau \rightarrow jj$	0.99	0.92
SUSY $H(500) \rightarrow \tau\tau \rightarrow jj$	0.99	0.94
$H(170) \rightarrow eeee$	0.99	0.99
$H(250) \rightarrow eeee$	0.99	0.99
$H(110) \rightarrow \gamma\gamma$	0.97	0.93
$H(135) \rightarrow \tau\tau \rightarrow ej$	0.99	0.94
$H(200) \rightarrow \tau\tau \rightarrow ej$	0.99	0.94

**Jets are included in cut sets for Taus**

- $|\eta| < 2.4$  due to tracker limits

**Electrons are Isolated - high luminosity**

**Isolation not considered - low luminosity**

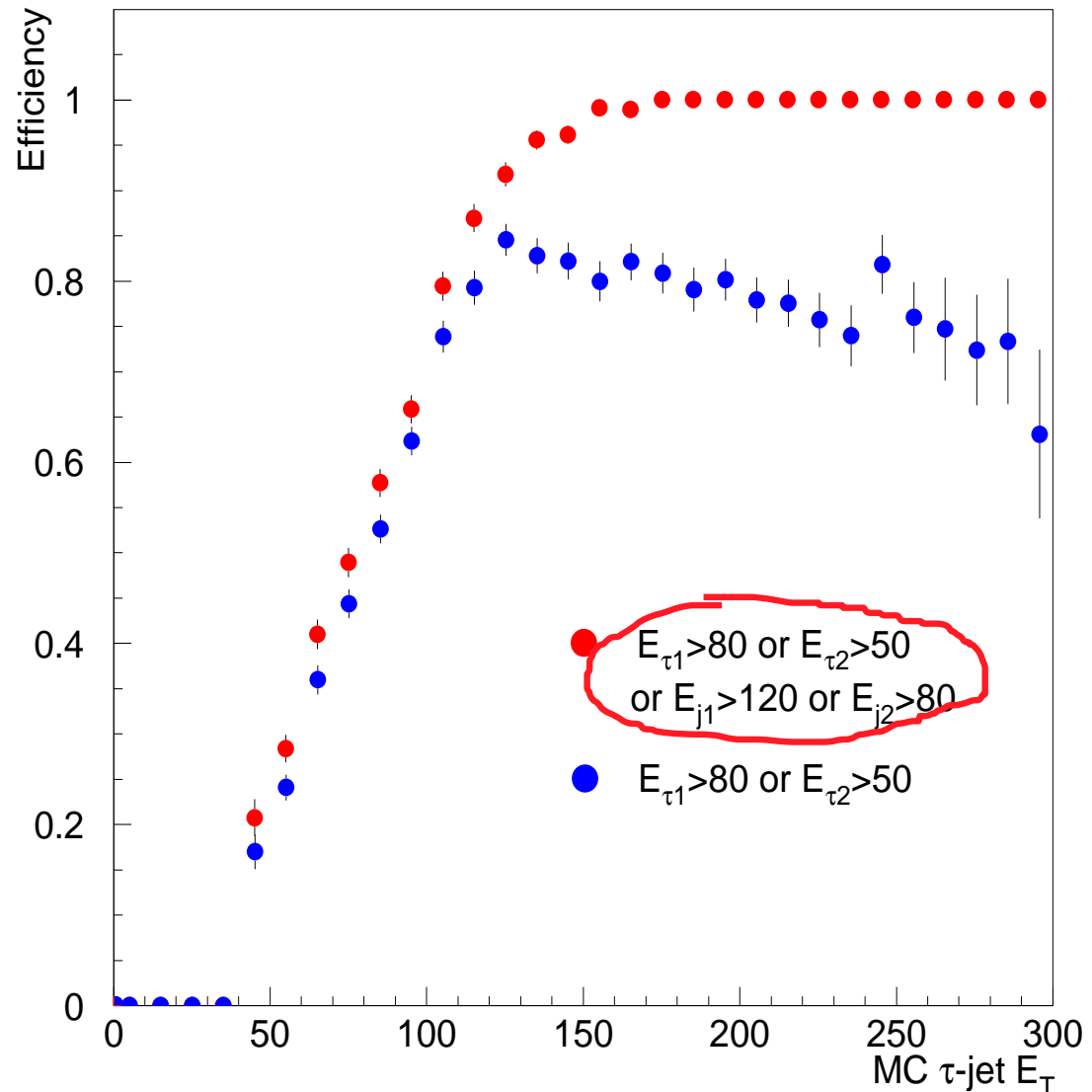


# High Luminosity $\tau$ Efficiency

**$H(200) \rightarrow \tau\tau \rightarrow jj$   
and  
 $H(500) \rightarrow \tau\tau \rightarrow jj$   
combined  
Tau is a jet  
with tau veto  
off**

- $|\eta| < 2.4$

$H(200) \rightarrow \tau\tau \rightarrow jj$  and  $H(500) \rightarrow \tau\tau \rightarrow jj$





# Summary

**Jet rates higher than previous**

- Resolution not as good as before

**Tuning of  $E_T$  cutoffs**

**Still needed:**

- **Efficiencies:**

- $t \rightarrow eX$  (Submitted for CMSIM Prod.)
- $B \rightarrow eX$  (Needs data card)
- More different physics processes

- $|\eta| > 3$

**$\eta$  dependent tower threshold studies**